

What is claimed is:

1. An image processing device for recognizing an outline of a moving target comprising:

5           an image pick-up means for taking a plurality of images in times series, in each of which said moving target exists;

          an image conversion means for converting said images into outline images;

          a memory for storing said outline images ; .

10           a first operation means for performing an operation with use of a reference outline image that is one of said outline images corresponding to said image taken at a reference time, a first outline image that is one of said outline images corresponding to said image taken at a first time other than the reference time, and a second outline image that is one of said outline images  
15 corresponding to said image taken at a second time other than the reference time and the first time, to provide a processed outline image having only outlines with any positional change that occurs between the reference time, the first time and the second time;

          a second operation means for performing an operation with use of said  
20 reference outline image, and a third outline image that is one of said outline images corresponding to said image taken at a third time other than the reference time, the first time and the second time, to provide a processed outline image having only outlines with any positional change that occurs between the reference time and the third time; and

25           an outline extracting means for extracting the outline of said moving target from the processed outline images provided from said first operation means and said second operation means.

30   2. The image processing device as set forth in claim 1, wherein said second operation means performs the operation with use of said reference outline image,

said third outline image, and a fourth outline image that is one of said outline images corresponding to said image taken at a fourth time other than the reference time, the first time, the second time and the third time, to provide the processed outline image having only outlines with any positional change that  
5 occurs between the reference time, the third time and the fourth time.

3. The image processing device as set forth in claim 2, wherein said first operation means performs the operation with use of said reference outline image that is said outline image corresponding to said image taken at the center of both  
10 of first and second time periods as the reference time, said first outline image that is said outline image corresponding to said image taken at a start time of said first time period as the first time, and said second outline image that is said outline image corresponding to said image taken at a finish time of said first time  
15 period as the second time, and wherein

said second operation means performs the operation with use of said reference outline image, said third outline image that is said outline image corresponding to said image taken at a start time of said second time period as the third time, and said fourth outline image that is one of said outline images  
20 corresponding to said image taken at a finish time of said second time period as the fourth time.

4. The image processing device as set forth in claim 1, wherein said first operation means performs the operation with use of said reference outline image that is said outline image corresponding to said image taken at the center of a  
25 first time period as well as an end of a second time period as the reference time, said first outline image that is said outline image corresponding to said image taken at a start time of said first time period as the first time, and said second  
30 outline image that is said outline image corresponding to said image taken at a finish time of said first time period as the second time, and wherein

said second operation means performs the operation with use of said reference outline image, and said third outline image that is said outline image corresponding to said image taken at the other end of said second time period as the third time.

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5. The image processing device as set forth in claim 2, wherein said first operation means performs a minimum operation between said first outline image and said second outline image, and then determines a difference between said reference outline image and a result of said minimum operation, to provide the processed outline image, and wherein

said second operation means performs a minimum operation between said third and said fourth outline images, and then determines a difference between said reference outline image and a result of said minimum operation, to provide the processed outline image.

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6. The image processing device as set forth in claim 3, wherein said first operation means performs a minimum operation between said first outline image and said second outline image, and then determines a difference between said reference outline image and a result of said minimum operation, to provide the processed outline image, and wherein

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said second operation means performs a minimum operation between said third and said fourth outline images, and then determines a difference between said reference outline image and a result of said minimum operation, to provide the processed outline image.

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7. The image processing device as set forth in claim 4, wherein said first operation means performs a minimum operation between said first outline image and said second outline image, and then determines a difference between said

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reference outline image and a result of said minimum operation, to provide the processed outline image, and wherein

5       said second operation means determines a difference between said reference outline image and said third outline image to provide the processed outline image.

8. The image processing device as set forth in claim 2, wherein said first operation means performs the operation with use of said reference outline image  
10       that is said outline image corresponding to said image taken a finish end of a first time period as well as a start end of a second time period as the reference time, said first outline image that is said outline image corresponding to said image taken at the first time within said first time period, and said second outline image that is said outline image corresponding to said image taken at a start end of said  
15       first time period as the second time, and wherein

      said second operation means performs the operation with use of said reference outline image, said third outline image that is said outline image corresponding to said image taken at the third time within said second time period, and said fourth outline image that is said outline image corresponding to  
20       said image taken at a finish end of said second time period as the fourth time.

9. The image processing device as set forth in claim 8, wherein a time interval between the first time and the reference time is equal to the time interval  
25       between the third time and the reference time, and a time interval between the second time and the reference time is equal to the time interval between the fourth time and the reference time.

30       10. The image processing device as set forth in claim 1, wherein said first operation means performs the operation with use of said reference outline image

that is said outline image corresponding to said image taken at a finish end of a first time period as well as a start end of a second time period as the reference time, said first outline image that is said outline image corresponding to said image taken at the first time within said first time period, and said second outline  
5 image that is said outline image corresponding to said image taken at a start end of said first time period as the second time, and wherein

said second operation means performs the operation with use of said reference outline image, and said third outline image that is said outline image corresponding to said image taken at a finish end of said second time period as  
10 the third time.

11. The image processing device as set forth in claim 10, wherein a time interval between the first time and the reference time is equal to the time interval  
15 between the third time and the reference time.

12. The image processing device as set forth in claim 8, wherein said first operation means performs a minimum operation between said first outline image and said second outline image, and then determines a difference between said  
20 reference outline image and a result of said minimum operation, to provide the processed outline image, and wherein

said second operation means performs a minimum operation between said third and said fourth outline images, and then determines a difference  
25 between said reference outline image and a result of said minimum operation, to provide the processed outline image.

13. The image processing device as set forth in claim 10, wherein said first  
30 operation means performs a minimum operation between said first outline image and said second outline image, and then determines a difference between said

reference outline image and a result of said minimum operation, to provide the processed outline image, and wherein

5       said second operation means determines a difference between said reference outline image and said third outline image to provide the processed outline image.

14. The image processing device as set forth in claim 1, wherein said outline extracting means performs a minimum operation between the processed outline  
10 images provided from said first operation means and said second operation means,

15. An image processing method of recognizing an outline of a moving target,  
15 said method comprising the steps of:

      taking a plurality of images in times series, in each of which said moving target exists;

      converting said images into outline images;

      storing said outline images ;

20       performing a first operation with use of a reference outline image that is one of said outline images corresponding to said image taken at a reference time, a first outline image that is one of said outline images corresponding to said image taken at a first time other than the reference time, and a second outline image that is one of said outline images corresponding to said image taken at a  
25 second time other than the reference time and the first time, to provide a processed outline image having only outlines with any positional change that occurs between the reference time, the first time and the second time;

      performing a second operation with use of said reference outline image, and a third outline image that is one of said outline images corresponding to said  
30 image taken at a third time other than the reference time, the first time and the second time, to provide a processed outline image having only outlines with any

positional change that occurs between the reference time and the third time; and  
extracting the outline of said moving target from the processed outline  
images obtained by said first and second operation steps.